

THEATRE COOLING

by

Carrier
AIR CONDITIONING
AND
DRYING EQUIPMENT

Carrier
Centrifugal Refrigeration
and
Air Distribution

Carrier
AIR CONDITIONING
AND
DRYING EQUIPMENT



*A Restful Refuge
Summer & Winter*



Every day a good day



TO William A. Johnston, Editor of the Motion Picture News, we are indebted for the splendid editorial, "Cooling the Theatre," with which we introduce this booklet. In a few brief paragraphs, Mr. Johnston has forcefully presented to theatre owners and operators the salient facts and requirements relative to a new and necessary asset in a great industry. It is gratifying to us, as engineers, to have led in the development which has prompted this editorial comment on the part of Mr. Johnston and his paper whose interests are impartially devoted to the betterment of the Motion Picture Theatre.

Carrier Engineering Corporation
NEWARK, N. J.

Cooling the Theatre

Reprinted from

MOTION PICTURE NEWS

JUNE 20, 1925



Editor of the
MOTION PICTURE
NEWS

W. A. JOHNSTON

A NEW box-office factor has just come to the fore which, it is already clear, is going to rank along with theatre location and the attraction on the screen.

We refer to refrigeration—the installation and operation of a scientific cooling plant.

Summer heat has always been the theatre's chief competitor; but it now appears that a serious liability may not only be wiped out but turned into a solid asset.

The day is here, by all accounts, when to the regular theatre investment of land and building will be added that of a refrigeration plant. It will be a necessity.



Last week while Broadway sweltered in the terrific heat wave, one theatre, the Rivoli, was well filled day in and day out. The manager informs us that, while ten thousand admissions would be normal for the week's run, the admission actually exceeded twenty-seven thousand.

The report stands out in bold relief against reports this week, of theatres closing here and there and the threatening wholesale closing of most of the theatres in one metropolis.

Evidently the matter is of supreme importance. If people can actually be brought to a theatre to get cool, there is created a brand new enterprise. Again it brings about competition that cannot well be met by any other offering.

We are bringing the matter forcefully to the exhibitor's attention. It ought to be generally and immediately investigated.

The installation cost of the right kind of a plant is considerable. It varies, of course, with the size of a house. The minimum cost today is around thirty-five thousand dollars. A motion picture engineer predicts that this will be lowered. Against this equipment figure, however, is to be placed the opportunity of three months a year paying business against shut down or loss.

The efficiency of the theatre cooling system has just recently been brought about. We are told by one large concern that laboratory experiments have been going on for some time and at very large expense. Today it is claimed that air in a theatre anywhere can be made as healthful and comfortable as the best of country air.

The laboratory experts state that three main factors are involved: air motion, humidity and temperature. These can be brought together at what is called a comfort point. Air can be made cool or warm as the seasons demand. The refrigerating apparatus controls humidity as well as temperature.

The point of the matter is this: The cooling system should be the best procurable. It must be scientifically right. It is a matter of public health and therefore too serious a thing to be bungled. In the entire matter the Technical Department of Motion Picture News is at the service of any exhibitor.

W. A. Johnston

30 VARIETY

PICTURES ONLY HOUSE STANDING UP LAST WEEK ON B'WAY, RIVOLI, \$19,746—COOLING PLANT

Everything Else Toppled Over—Capitol, \$32,000—
Strand, \$20,000—Four Independents Called
Upon to Suffer—F. P. Used Own Pictures in Own
Houses—More Independents on Street This
Week—Rivoli's Remarkable Showing—House
May Become "Cooling Station" in Hot Spells

WARNER'S

Sweltering New Yorkers paid lit-
tle attention to the attractions that
were offered at the Broadway pic-
ture houses last week with the re-
sult that the street as a whole
showed a record low. Last week
was the first from a heat stand-
point the town has experienced in
some time and the wave continued
from Monday until Sunday night,
with the theatres for the greater
part playing to but a handful of
practically all performances.
Said that he
cost.
Esti-
Cameo-
(P. D. C.
from the
Did flop
Capitol

Rivoli—"The Little French Girl" (F. P. 1,
2,200, 50-85-99.) With new cooling plant,
marvel in its way, this house got \$19,746 result
remarkable showing in face of weather. When
effectiveness of cooling plant becomes generally
known public will make house cooling station
in event of another hot spell.

Rivoli—"Are Parents People?" (F. P. 1, 2,200,
50-85-99.) The air cooling plant at this house
looks as though it is more than going to pay
for itself in one season on the strength of
added business attracted in face of the hot
weather. Word of mouth advertising has gone
about the town to the effect that the Rivoli is
the coolest place in the city and the business
has reflected it. Last week's business of \$20,
804 is probably about \$6,000 over what the
house would have done without the cooling
plant.

Business was rather uniformly bad, with the
possible exception of the Rivoli, where \$19,746
was the draw. In the face of conditions this
might be considered a record week for the
gross is about an average of what the house has
done at times during the height of the season.
The newly installed cooling system is most
accountable.

MR. JOHNSTON has been most deliberate, and justly so, in com-
menting editorially on the subject of Theatre Cooling. Efforts to
create comfortable Summer conditions in theatres are not new
but have, with few exceptions, been marked by only slight suc-
cess or complete failure. The failures have served not only to
make theatre owners dubious as to the possible accomplishments
of systems designed to create comfortable conditions within the
theatre, but have prejudiced the public against extravagant claims
that have proven false.

We wish immediately to emphasize Mr. Johnston's paragraph
relating to the three factors which must be controlled in combination



to produce conditions of physical comfort in a theatre or other building where people congregate. These are: humidity, temperature and air movement. Of the three, the most important factor is the relative humidity of the air. This too is the condition of the atmosphere least subject to control by ordinary methods. It is primarily in creating and controlling proper conditions of relative humidity that the science of air conditioning differs from the usual practices of heating and ventilating. A detailed discussion of the importance of relative humidity and its control is given in a subsequent section.

The past failures in attempts to create comfortable conditions in theatres have resulted from ignorance of the fixed relations pertaining to the conditions of the air or from efforts to establish these conditions through the control of but one or two of the combined factors cited. Fan systems alone produce air movement but have no effect upon temperature or humidity. Air washers cleanse the air, and reduce the temperature to some extent but in most localities will cause such an increase in relative humidity that conditions of comfort are made worse rather than improved. Finally, systems have been designed to control all of the necessary conditions but have failed through the lack of experience and engineering skill on the part of the designers.

In a previous paragraph we have said that false representations as to the comfort in theatres have served to prejudice the public. We do not speak against psychological cooling effects in lighting and decoration which have unquestioned value in inducing Summer business for theatres and can well augment the best of cooling systems. It is the so called "bunk" advertising that the progressive theatre men are advising against today. The motion picture industry has gained dignity and with this the type of patronage at theatres has changed. Managers have learned that their best source of attendance is made up of people who *make it a habit* to come to their theatre with each change of program. False advertising as to cool interiors and the most subtle of psychological effects may attract once or occasionally, but if the theatre is not comfortable, box office receipts are bound to slump.

We realize that it is quite unnecessary to tell theatre men their own troubles which they know too well. The space is more valuable to tell you of the remarkable results that are being accomplished in theatres which are *manufacturing their own weather* by means of the Carrier System and how any theatre or public building can be made a place of supreme comfort every day in the year.

Yes, Mr. Johnston and the owners of better theatres have been very conservative in this matter of theatre cooling. They have waited to be shown conclusively that there is a Mechanical System that is capable of creating and maintaining comfortable air conditions in a theatre throughout the year. Their enthusiasm now seems unbounded and we value their support the more because they have been conservative

Manufactured Weather from Los Angeles to Broadway



Mr. Sid Grauman, builder of the first scientifically air conditioned theatre. Mr. Grauman, wearing the cap, stands between two All-Americans whom he brought to Los Angeles for his opening of "The Covered Wagon."

THREE years have passed since that Master Showman, Mr. Sid Grauman, and his associates, planning to produce the last word in motion picture theatres, directed that a Carrier System be installed as one of the prime features of the Metropolitan Theatre at Los Angeles.

We realized from the beginning that this was a new and tremendous problem. In this we must succeed! It was the opportunity for which we had been waiting. Here was a daring showman who did not stop to compare the price of a set of buzzing fans with a system that would literally *Manufacture Weather* within the theatre. We knew that to succeed in this installation would mean that all of the better theatres would eventually make properly engineered air conditioning systems an essential part of their equipment.

The conditioning—heating, cooling, ventilating—of the modern Motion Picture Theatre is a technical problem requiring for its proper solution, a long and broad experience.

In our twenty-five years of experience we have never encountered any air conditioning problem more complicated, or involving more painstaking care and engineering knowledge than the Motion Picture Theatre.

The very nature of the building—its size, as a single enclosure; its great cantilever balcony overhanging the main floor; the tall opening of the proscenium; the fact that it is occupied for twelve hours each day,—renders the design of adequate air conditioning equipment extremely difficult.

The heat from myriads of lights must be counterbalanced and removed in summer, *utilized* in winter.

The apparatus itself must be placed in difficult places, so that it will not interfere with the design and decoration of the building, or occupy valuable space. Finally, the greatest care must be used to make the entire system noiseless.

Our entire engineering staff threw its energy into this problem for a period of many months. The time and effort was well spent. The system was a complete success. Throughout its three years of operation "Every day has been a Good day," with no seasonal slump at Grauman's Metropolitan.

The prediction which we made at the time of this premier of Carrier Manufactured Weather in the theatre has also been justified. We said briefly: others must follow, for it means the death of the theatre's keenest competitor, the weather.

*A glimpse of
the Mezzanine Foyer,
Grauman's
Metropolitan
Theatre.*



*W. L. Woollett
Architect
Artist*



The cooling tower atop the Palace of Dallas where condensing water is re-cooled for the Carrier Centrifugal Refrigeration System. The tower is also utilized to tell the world that the Palace has "Manufactured Weather."

The commodious first portion and convenient parking grounds of the Palace, Dallas.



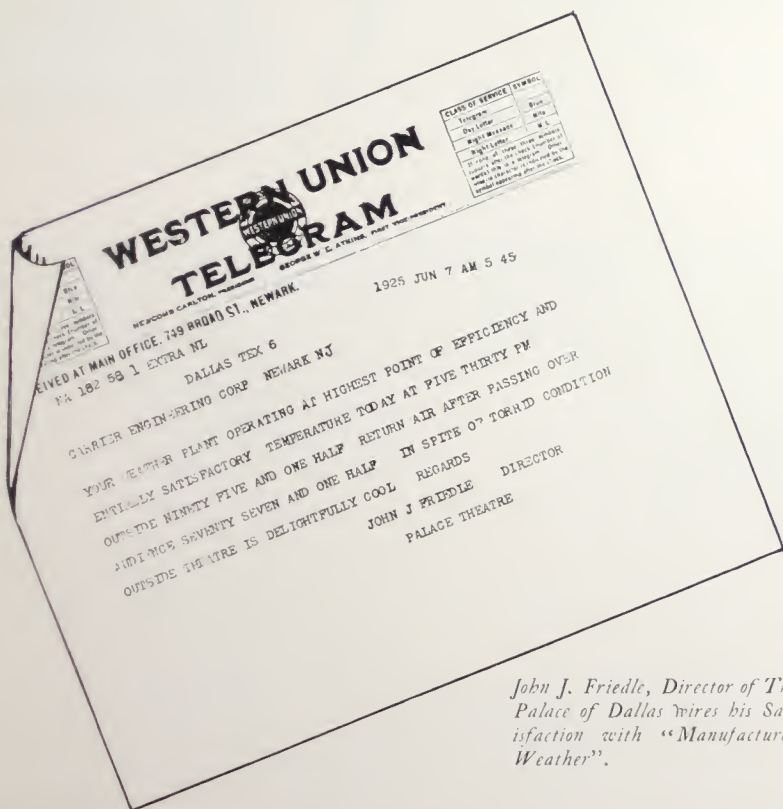
THE success of the System in Los Angeles was sufficient to cause Mr. Harold B. Franklin, head of the Paramount Theatre Division, together with Mr. Robert E. Hall and Mr. Albert L. Baum, Consulting Engineers, to recommend that a Carrier System be placed in the Palace Theatre, a Paramount House at Dallas, Texas. Here was a *real test*; if it succeeded in that climate it could be used anywhere.



Carrier Engineering Corporation



The system in the Palace at Dallas is now in its second year of operation. From a theatre which suffered a deficit each Summer, the Palace has mounted practically to the top of the Paramount profitable shows. A fact worth noting, in passing, is that the system has proven a decided asset for Winter business as well as Summer. The telegram reproduced below from Mr. John Friedle, Director of the Palace, is prime evidence of their enthusiasm.





IRIS

Houston, Texas
6/19/25

Houston, Texas
6/19/26

Mr. S. P. Becker,
Carrier Eng. Corp.,
1409 Humboldt Bldg.,
Chicago, Ill.

Dear Mr. Becker:

The writer extended his stay in New York longer than he expected, the delay in answering your letter being in Houston, as you just expected. What you The best I can say, it is Revolutionizing picture going. In the past ten weeks or so, and the head of the Texas, which get inside of the doorway of the Texas you can hear revolution of delight. The plant is working perfectly. Mr. Becker says "he has nothing to do on the job but

Sincerely yours,
Will Horwitz, Jr.

A head of the almost extinct Texas Long Horn measuring 8 feet from tip to tip is an impressive decoration in the lobby of the Texan.

"Revolutionizing picture going!"

Will Horwitz, Jr.

**WESTERN UNION
TELEGRAM**

| | |
|-----------|---------------|
| FROM 100% | |
| NO. | DATE AND TIME |
| MILE | |
| TIME FILE | |

1925 JUN 7 AM 9 19

AA 4 30 2L 1/7

HOUSTON TEX 6

CARRIER ENGINEERING CORP.

VENTURE NY

TWO PM OUTSIDE TEMPERATURE NINETY ONE HUMIDITY SEVENTY SIX INSIDE TEMPERATURE SEVENTY SIX HUMIDITY SIXTY SIX THE PEOPLE OF HOUSTON ARE SO FAR SOUTH AND THEIR BLOOD SO THIN THEY ARE UNABLE TO STAND TOO LOW INSIDE TEMPERATURE STARTING AT SEVENTY FIVE DEGREES WE RAISE THE DROPS SLOWLY UNTIL THEY GET UNCOMFORTABLE TOO COLD NOW WE MAINTAIN OUR INSIDE TEMPERATURE AT SEVENTY SIX ALL THE TIME OUR PLANT IS HARDLY WORKING THE HUMIDITY FEELS AND SMELLS LIKE A SPRING DAY REWARDS FROM A PERFECTLY PLEASED CUSTOMER

WILL HORWITZ, JR.
TEXAS TELETYPE

A Round alien in our man
frustrated salesman.

ANOTHER progressive Texas showman saw the possibilities which Carrier Manufactured Weather held for his theatre, even before the

Palace installation was completed. This man is Mr. Will Horwitz, Jr., owner of the Iris in Houston and who has since built that very novel small theatre, The Texan, in Houston. It was when he was planning the Texan that he said, "I shall include Carrier Manufactured Weather." The Texan opened in April of this year, 1925. The satisfaction which Mr. Horwitz is enjoying with Manufactured Weather is well evidenced in his letter and telegram which are here reproduced.



Carrier Engineering Corporation



The Missouri, "The Show Place of St. Louis," a Carrier Cooled refuge from the heat.

Installations of The Carrier System are in various stages of completion in the following theatres:

The Missouri, St. Louis; The Capitol, Chicago; The Herald Square, Joliet, Ill.; The Lyric, Indianapolis; The Miami, Miami, Fla., and The Keith Theatre at Atlanta, Ga. Before this book goes to press "Manufactured Weather" will have begun to make "Every day a Good day" at the Missouri in St. Louis and Carrier Refrigeration will be cooling the air for The Capitol in Chicago.

In addition to these theatres, our Engineering Department is laying out plans preparatory for contracts with some twenty theatres throughout the country.

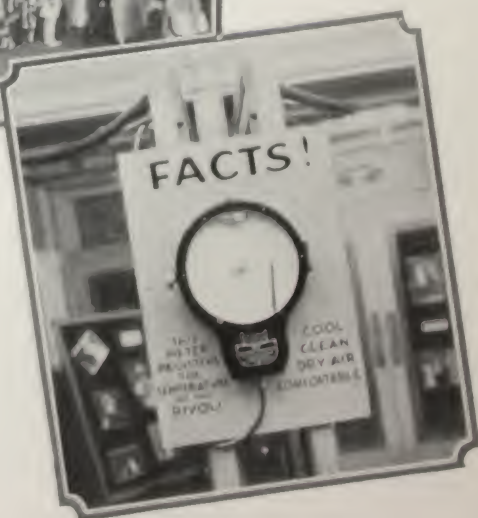


The magic interior in the Capitol Theatre at Chicago, created by Mr. John Ebersson, Architect. Here Carrier Centrifugal Refrigeration completes the effect of an ideal open air atmosphere.



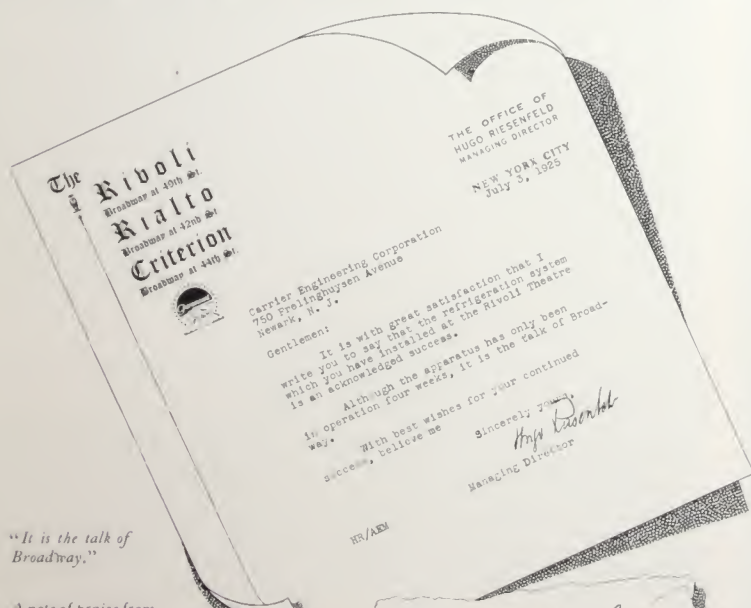
People are willing to stand in line for they know that a refreshing atmosphere awaits them in the Rialto.

The inside facts of the Rialto presented to the public by a recording thermometer at the entrance.



FINALLY, it is with great satisfaction that we mention the remarkable results which Carrier Manufactured Weather is accomplishing in the Rivoli on Broadway. The system was set into operation with the first day of this season's unprecedented heat wave. During the first June week of record heat the Rivoli attendance exceeded the normal attendance of the corresponding week of previous years. Each week since then the attendance has increased until, at this writing, after five weeks of operation, the attendance is more than 100% above the normal for the season. The other theatres in New York have, without exception, suffered serious losses. These are facts that can be verified by anyone who is interested.

It did not take the public long to learn that "The Rivoli is the Coolest Spot in Town." No sensational or extravagant advertising has been required or used. The simple facts have been stated and the patrons have learned that they are true. Word of mouth advertising has done the rest. Manufactured Weather has Scored on Broadway.



"It is the talk of Broadway."

A note of praise from Dr. Riesensfeld.

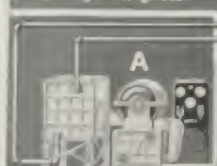
Below: A Scrap of Paper. A message of satisfaction written by a delighted patron and left in the suggestion box at the Rivoli.

The air in the Rivoli is cool and refreshing in the hottest weather - I nearly missed trying it as I have been fooled so often by painted icicles in hot movies. Why not blow a sample of cool air onto the sidewalk?

Carrier

System of Theatre Cooling

Carrier
Centrifugal Refrigeration



A

Cold Water →

← Return Water

Fresh Air

Pump

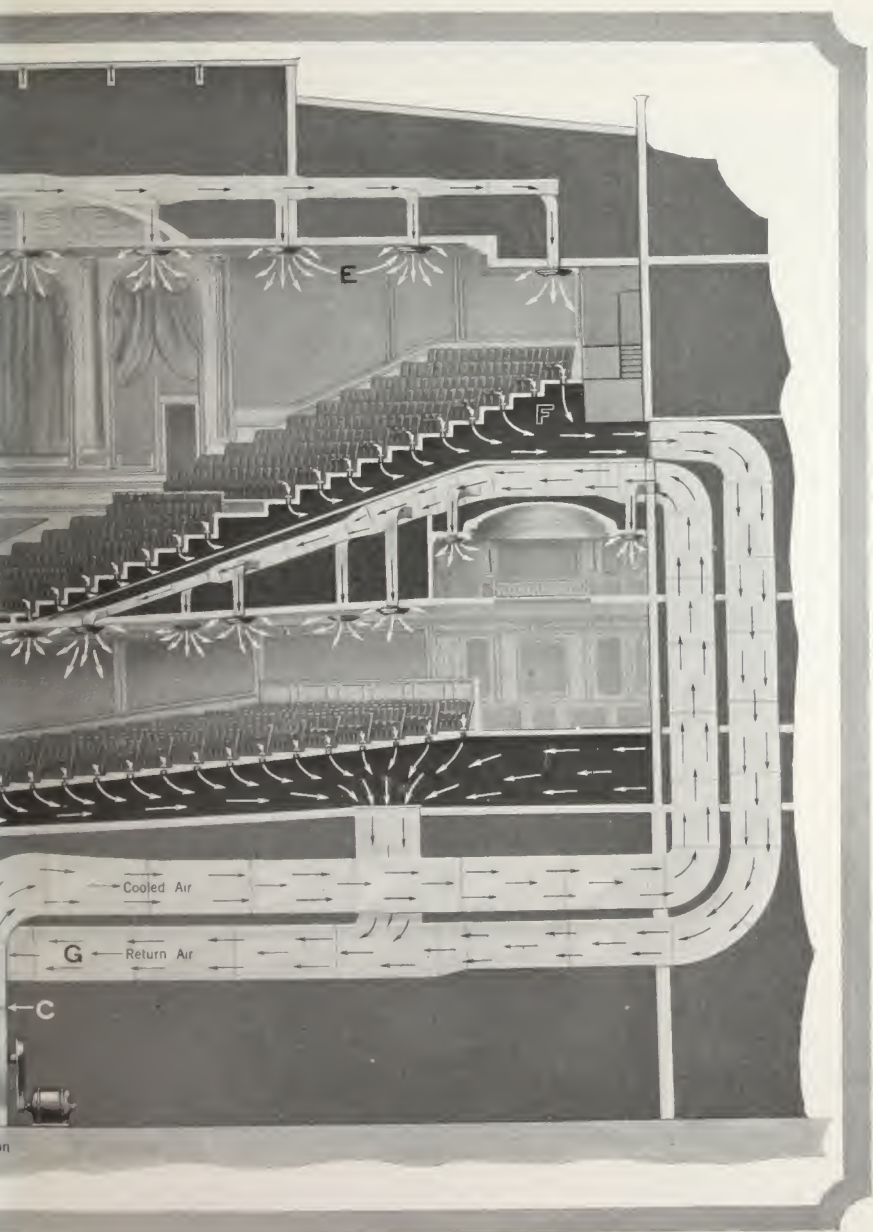
Carrier Dehumidifier

Cooled Air

Cooled Air

Cross Section of a Typical Theatre Equipped with a Carrier

- A. The Carrier Centrifugal Refrigeration unit which cools the water for the spray chamber
- B. The spray chamber or dehumidifier where the air is dehumidified, cooled and cleaned
- C. The centrifugal fan which draws the air through the spray chamber and passes it through metal ducts to the theatre
- D. The larger metal ducts through which conditioned air is passed to the seating of the theatre



System for Cooling, Conditioning and Distributing Air.

E. The downward diffusion outlets through which the air is diffused over the audience, reaching the Breathing Zone first with complete absence of draughts.

F. The chambers beneath the balcony and orchestra seats into which the air is drawn from the theatre

G. The large metal ducts through which the used air passes back to the spray chamber to be rewashed, cooled dehumidified and mixed with fresh air.

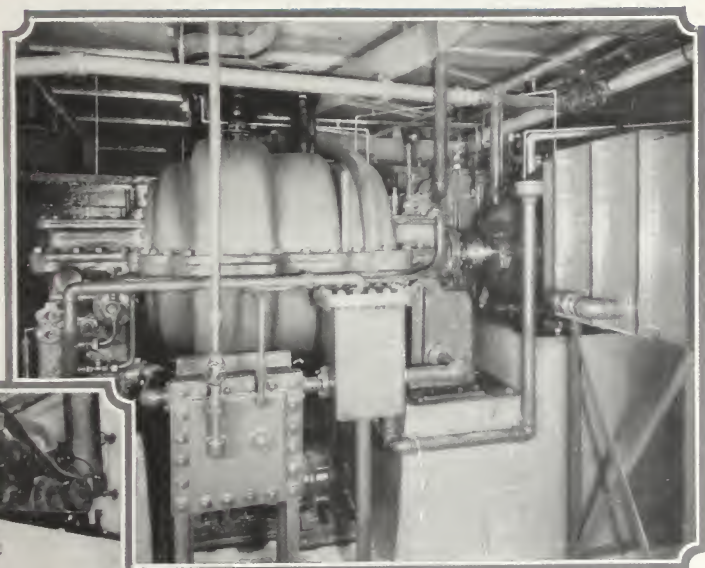


Hawkins of the Rivoli said "Yeh, Suh! I reckon ten times as many fine cars drive up to the Rivoli since the new 'Man of the Year' Weather."



and the Rivoli where "Lost A Wife" showed \$22,092.25. The later compared to the same week of 1924 is an increase of more than 100 percent, for the week of June 28, 1924, with "Changing Husbands" the Rivoli had \$10,803. The Rivoli's cooling plant is given credit for attracting a greater part in the business last week.

VARIETY JULY 1, 1925



The Carrier Centrifugal Refrigeration System.

*Patrick J. Ryan,
Engineer, of the Rivoli.*



I have operated all of the well-known types of refrigeration systems during my twenty years experience as an operating engineer.

This new Carrier Centrifugal System of Refrigeration is remarkable. It requires practically no attention; its operation is controlled automatically; it occupies a very small space for its capacity, and it is absolutely safe in operation.

Patrick J. Ryan

AMUSEMENTS

PRICE 20c

TIMES SQUARE

MUSEMENTS

THE

VARIETY

WEDNESDAY, JUNE 17, 1925

CROSS

56 PAGES

VOL. LXXIX. No. 5

NEW YORK CITY, WEDNESDAY, JUNE 17, 1925

B'WAY'S LOWEST GROSSES

PAID \$6,000 WEEKLY AND
EACH FILM

\$3,000 FOR SOME
SHOWS, \$1,500
FOR OTHERS

LOW GROSSES ON BROADWAY
CONTINUE; \$1,500 FOR SEVERAL

FOREIGN

Too Hot for Deadheads

NEGRO TROUPE IN BERLIN BADLY
HANDLED WITH DUBIOUS FUTURE

Placed in Wrong House at \$5 Top—May Do Variety
Turn on Cabaret Revue—Worth \$700 Nightly—
No One Looked After or Advised Players
Conduct Year's Work

Record Low Marks from
June's Interior Heat Con-
tinue — Shows Cutting
Homes with Few Hanging
On for Picture Rights Sale
— "Rose Marie" — "Pal Joey"
and "Lovers 14th" Look
Set for All Summer
Two New Musicals Heat

PICTURES

The image shows a newspaper clipping with the word "STOCKS" printed in large, bold, capital letters at the top center. Below this headline, the page is filled with multiple columns of text, which appear to be financial news or market reports. The text is somewhat blurry and the paper has a yellowed, aged appearance. The layout is typical of a newspaper's financial section, with dense, justified text columns.

PICTURES

Wednesday, June 16, 1968

SAD \$\$ TALES OF A HOT WEEK

... WITH 'EVE'S SECRETS' ...

1992-1993 1992-1993

[illegible]

MET WITH 'EVE'S SECRETS' 22

PICTURES

RIVOLI'S NEW COOLING SYSTEM
RESPONSIBLE FOR GROSS OF \$20.8

\$6,000 Above for Time of Year - People Aware of
Theatre's Civil Interior - Capital's Season's 1
Last Week, \$31,000

"PLAYING WITH SOULS"

TIMES SQUARE

COOLING SYSTEMS THAT WORK

THE SCREEN

THE

By George Gerbasi

Health and Comfort in the Theatre "Manufactured Weather"

WITH such results as have been demonstrated by the use of scientific air conditioning in theatres, no theatre owner can long ignore its adoption as a necessary asset. In this connection we have a warning to offer which we trust will be properly understood. The number of theatres which will be able to obtain properly designed and installed air conditioning systems within the near future will be very definitely limited by the relatively few engineers who are equipped through training and experience to design such systems and produce the necessary equipment.

It is a foregone conclusion that individuals and firms with no knowledge or ability in this field will launch forth to reap what appears to them to be a rich harvest. Some theatre owners in their anxiety to acquire what has proven profitable to others may make the mistake of buying equipment without due regard to engineering. We are earnest in seconding Mr. Johnston's advice as expressed in his editorial that, "It is a matter of public health and a theatre's reputation and too serious to be bungled." Learn what the real requirements are and be sure of the ability of the engineers.

Humidity and Temperature *The Thermometer Lies!*

We choose now to lay before the reader the elementary facts relative to conditions of air effecting physical comfort and health and to describe Carrier Equipment which efficiently creates and maintains ideal air conditions.

To the average person, physical comfort is thought of or expressed entirely in terms of temperature. We are all familiar with the rather hackneyed phrase, "It isn't the heat, it's the humidity," or as the dear old Irish lady expressed it, "It aint the heat, it's the Humanity." Few understand just how much of fact there is in this common expression. You will realize its true importance, however, if you will recall a day when the thermometer registered 75 or 80 degrees, which isn't really hot, and yet you felt smothered and oppressed. You called it "close" and "muggy" and the "weather man" probably said the humidity was excessive. That's exactly what was the matter! When the humidity is too high, the perspiration does not readily evaporate from the body and that sticky oppressed feeling is the result.

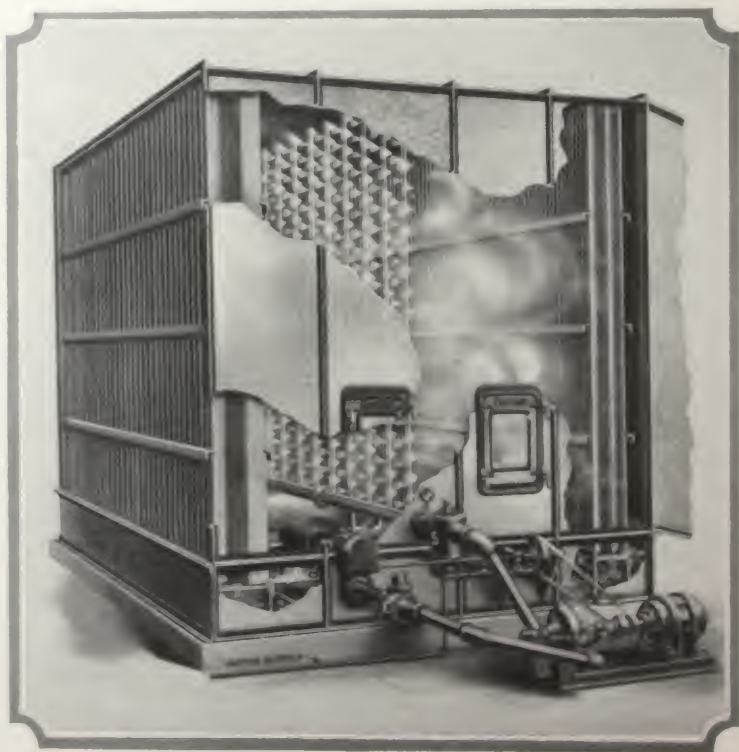
Here are facts based upon extensive experiments made in actual practice by the American Society of Heating and Ventilating Engineers. The human body experiences exactly the same feeling at the following temperatures and conditions of relative humidity.

| Temperature | Relative Humidity |
|--------------------------------------|-------------------|
| 95° Fahr. with 10% Relative Humidity | |
| 90° " " 23% " " | |
| 85° " " 43% " " | |
| 80° " " 68% " " | |
| 75° " " 100% " " | |

This means that 95° Fahrenheit, when the air is but 10% saturated seems no warmer to one's body than when the air is at 75° Fahrenheit (20° cooler) but saturated, that is, in a muggy condition.

The reverse of this condition usually prevails in heated buildings during the winter. It is common to note a room temperature of 75° or 80° and at that temperature to have a sense of chill accompanied by dry, parched membranes of the nose and throat. This is due to the fact that the cold outdoor air brought into the building and heated contains but a small amount of water vapor. The result is an excessive evaporation from the body and from the membranes accompanied by the chilling effect. To raise the temperature under these conditions does little to increase the feeling of comfort, since this would but increase the rate of evaporation from the body. It is much more effective to raise the humidity of the air.

So, you see, the humidity of the air is even more important to physical comfort than the temperature, and that it is entirely possible for the thermometer to lie about one's feeling of comfort.



Typical Carrier Dehumidifier or Humidifier. Air enters at right, thru the Baffle plates, passes thru the Spray Chamber and leaves at the left, thru the Washer Eliminator Plates.

Air Movement

Winds, Breezes and Drafts

There is another instance when the thermometer proves deceptive with regard to physical comfort. The temperature is 60° Fahrenheit on a sunny March day but a strong wind is blowing. You have called it "raw" and "penetrating" yet the air is not cold. The effect of air moving at a high velocity over the body is to produce excessive evaporation and to remove heat so rapidly from the body that a sense of chilling results. In this effect lies the danger of direct exposure to the blast of an electric fan or to currents of air introduced into an audience at high velocities.

In contrast to violent air movement, you have also observed those perfectly still days in Summer when the leaves on the trees are as still as pictures, when you would almost pray for a little breeze to lift the stifling oppression.

Finally, you know the pleasurable and refreshing feeling when balmy air stirs gently over you.

So, this is another consideration when we are planning to create ideal conditions of comfort in a theatre. We must know just *how* to *pour* the air into the theatre so that it will reach every corner of the house and yet will not create draughts.

The combinations of conditions of humidity, temperature and air movement which produce the maximum in physical comfort have been prescribed for us through the extensive and enlightening research of the American Society of Heating and Ventilating Engineers. For each given rate of air movement there is a combination of temperature and humidity which produces the greatest sense of comfort. These relations are quite as definite and fixed as the freezing or boiling point of water. The importance of recognizing and adhering to these established physical laws in attempting to produce ideally comfortable and healthful conditions in public buildings cannot be over emphasized.

"Manufactured Weather"

Now, you will want to know something of Carrier Equipment and how we manufacture Weather to meet the requirements which have just been presented.

Removal of Moisture from the Air

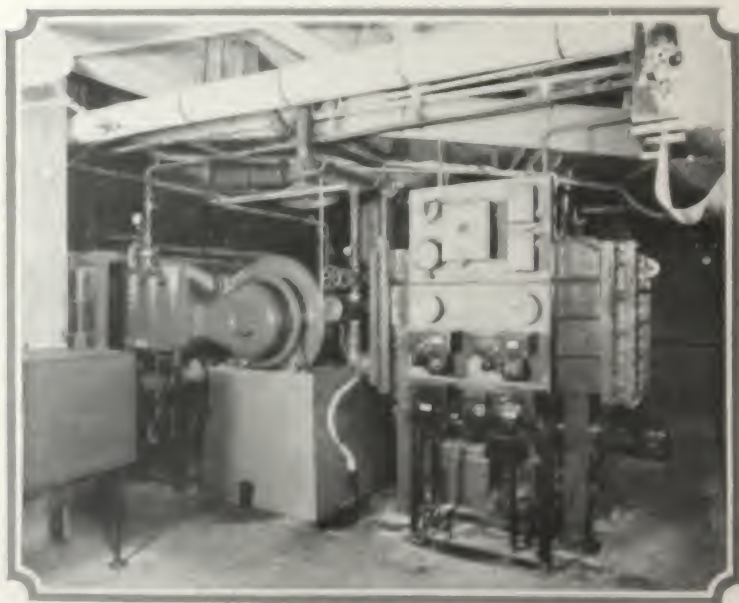
The removal of moisture from the air is termed *Dehumidification*. To reduce the moisture content of the air, that is, to *dehumidify*, is the most important problem in producing summer comfort.

You have seen the moisture from the air condense on the sides of a pitcher of ice water? Well, that's the principle by which we accomplish dehumidification. To do this the air which is to enter the theatre is blown through a chamber in which hundreds of small nozzles are each spraying a perfect cloud of cold water. The photograph on the opposite page is of such a chamber, a Carrier Dehumidifier. The dehumidifier may also be seen in the large photograph of a typical theatre at the center of the book.

In passing through these sprays the air and the water vapor, which it contains, are cooled to a point where much of the initial moisture is condensed into the spray water.

It seems a paradox, doesn't it, that we should be able to reduce the humidity of the air by blowing it through a cloud of water? It is a fact, however, that the air leaves the chamber with a dew point temperature many degrees lower than when it entered. The dew point of the air, you will understand, is the temperature at which the water vapor in the air begins to form a cloud or condense. The more water vapor the air contains the higher will be its dew point.

The secret of the dehumidifier, as you will guess, is that the water which issues from the sprays has been artificially cooled to a predetermined temperature under automatic control. No ordinary supply of water is sufficiently cold to cause the necessary condensation.



The address, control and insurance point, Carrier Commercial Refrigeration. At the left the high speed refrigerated electric motor which turns the compressor.

To cool the water which lowers the temperature of the air and reduces its humidity refrigeration is required.

Herein lies the most notable development in equipment for creating proper conditions of the air in theatres and similar public buildings. Dehumidification and the use of refrigeration in this connection is not essentially new; for we have long been accomplishing these effects in industrial plants. The familiar forms of refrigeration equipment have, however, in many cases proven most unsatisfactory. The reasons for this are briefly: complicated operation, hazards to the public due either to the nature of the gases used or to the high pressures at which it is necessary to operate and finally the extensive space required.

Carrier Centrifugal Refrigeration

THE Carrier Centrifugal System of Refrigeration has successfully eliminated all of these difficulties. It is a complete innovation in refrigeration and is revolutionizing particularly that field with which we are here immediately concerned, the cooling of public buildings.

Here are the outstanding advantages of Carrier refrigeration.

The refrigerant used is a harmless, stable liquid which produces cooling simply by evaporation when it is subjected to conditions of vacuum.

To produce the vacuum necessary for this evaporative cooling there is a centrifugal compressor. The compressor is nothing more than a series of centrifugal fans mounted on a single shaft within a vacuum tight casing. This is turned by a motor directly connected to the shaft. There are no valves or cylinders as in other systems. The only contact parts are the main shaft bearings.

The entire refrigerating system operates at pressures considerably below that of the atmosphere with the result that outward leaks are impossible.



The Centrifugal Refrigeration unit at the Texan.

The complete refrigerating unit with all auxiliary parts occupies less than one-quarter of the space of any other system of the same capacity. The unit can be tucked away with perfect safety and convenience into a corner of the basement, or any other part of the building that is available. An idea of its location and appearance in a theatre may be

had by referring again to the large picture at the center of the book.

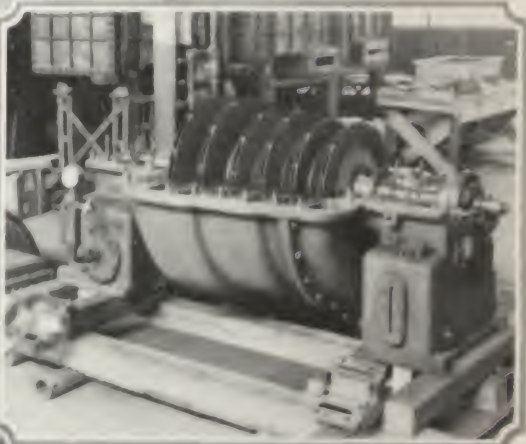
The complete refrigeration installation at the Rivoli, as an example, occupies a room approximately 12 feet square.

Operation of the centrifugal refrigeration system is completely automatic and requires only such ordinary attention as is given to fans and motors.

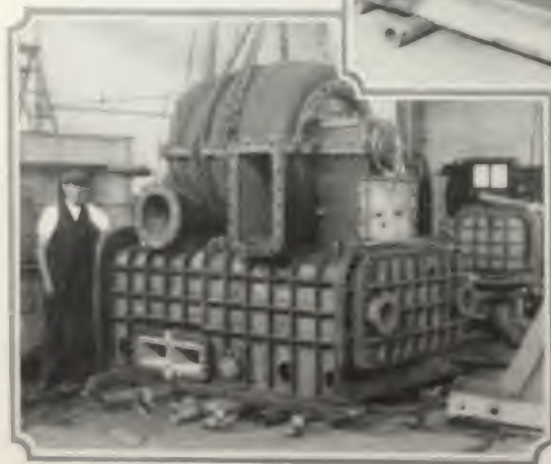
We have digressed to describe this remarkable, new refrigerating system. We have done so in the briefest possible manner and have omitted much, for the sake of brevity, that would be of interest to an engineer investigating new developments in this field. Our Engineering Department will freely give such additional information upon request.



Assembling Centrifugal Refrigeration unit in the Carrier Shops at Newark, New Jersey.



The Carrier Centrifugal Refrigeration compressor with top of casing removed. Note the six centrifugal rotors on the shaft. The only system of moving parts is in the six shaft bearings.



A Carrier Centrifugal Refrigeration Compressor assembled and mounted in the condenser in a box. This particular unit is capable of producing 240 tons of refrigeration each 24 hours.

Air Temperature Reduction and Control

Let us return now to the dehumidifying or spray chamber in which the air is conditioned. You understand how the humidity is reduced in the dehumidifier. Remember; neither ice nor frosted pipes are used; the refrigeration machine simply cools the water which is sprayed into the chamber through which the air is blown. One or more of these dehumidifiers may be placed at any convenient locality in the theatre, in the basement or in the attic or in a detached room. The distance from the refrigeration machine is not of consequence. It is simply a matter of piping the cold water from the refrigeration machine to the spray chamber.

Reduction in the temperature of the air is also accomplished in the spray chamber. In fact, the air leaves the chamber at a lower temperature than it would be desirable to admit it to the theatre. Automatically controlled dampers regulate a mixture of warm air with this refrigerated, dehumidified air so that it is admitted to the theatre at just the desired temperature.

Cleansing of Air

A third and very important process is accomplished as the air passes through the water sprays. This is the complete cleansing of the air from all dust and foreign matter. It is astounding to see the quantity of dirt that is collected in the tank at the base of the spray chamber after a few days' operation. Such dirt would be delivered to the house by ordinary fan systems and quantities of it would be deposited in the noses, throats, and lungs of the audience.

Distribution of Air

The Carrier Downward Diffusion System

From the spray chamber or dehumidifier where the air is cooled, dehumidified and cleansed, a single centrifugal fan draws the air, and delivers it through metal ducts to the top of the theatre. Through carefully designed diffusers, located at frequent intervals in the high ceiling of the theatre and in the ceiling under the balcony, the refrigerated air is literally poured or diffused over the audience. From the ceiling this blanket of conditioned air passes down over the audience so gently that there is no sense of draught. In passing down to the audience the refrigerated air is warmed to some extent by the theatre lights and by warmer currents of air. Automatic instruments are adjusted to regulate exactly the temperature at which the air reaches the audience and the capacity of the system is varied entirely automatically as the crowd increases or decreases.



The Breathing Zone First

By the downward diffusion system the air reaches the *breathing zone first* and at just the right temperature. This is important and as it should be. We want the fresh, clean, cool air to enter our lungs. It then passes over the bodies of the occupants, gathering the bodily heat and doors, then to the floor and low points of the theatre from whence it is drawn out of the theatre to be re-washed, re-cooled and mixed with fresh air.

The occupants of the theatre are not conscious of the source of this constant supply of cool, refreshing air. They have only that sense of *perfect comfort* and this applies to every section of the house. The balcony receives a copious supply of cool air and in every installation of the Carrier downward diffusion system the balcony temperature and humidity are the same as those in the orchestra.

The introduction of the downward diffusion system of air distribution in theatres has proven to be one of the most important improvements in this science during recent years. It had previously been the practice to introduce cold air to the theatre through "mushroom" outlets located beneath the seats. Some engineers have inadvisedly adhered to this practice even in recent installations. If we enumerate the effects produced by the up-draught system of introducing air, the advantages of the downward diffusion system, as outlined above will be even more evident.

Air admitted beneath the seats comes into contact with the floor first. It then passes over the feet, legs and bodies of the audience finally to reach the *breathing zone*. In instances where the air is cooled sufficiently to reduce the temperature over the entire audience, the air entering beneath the seats is so cold as to cause extreme discomfort on the feet and ankles and is a positive source of danger to health. If the air has been cooled sufficiently to produce an effective reduction in humidity, it then must be reheated by the use of steam heaters before being admitted to the audience through floor openings. This is an absolute waste in operation when compared with the downward diffusion system.

Winter Conditioning The Same Equipment Does It

Though air cooling and conditioning in the theatre in the Summer-time is the problem which assumes the greatest prominence just at present, Winter conditioning is destined to receive an equal amount of attention once the public learns what can be accomplished in this direction. We know of one house that attempted to shut down its Carrier System in the Winter. A distinct drop in attendance was noted. They resumed operation and the attendance returned to normal. The patrons had learned to *Feel for Themselves*.

The important fact which we want theatre men to know is that the same equipment which cools, dehumidifies and ventilates in Summer, cools and controls the same ideal air conditions in the theatre in the Winter. It is not required, of course, during this season



to operate the refrigeration machine. Cool dry air is drawn in from the outside and passed through the spray chamber where the humidity is *raised* to a predetermined point, which we have explained, is desirable in the Winter time. Such heating as is required in Winter is produced by automatically controlled steam heaters located in the ducts through which the air is supplied to the theatre. Thus, radiators located in the theatre are entirely eliminated.

We have heard it said that, "the downward diffusion system is all right for cooling, but it's all wrong for heating because heated air naturally ascends and should be introduced at the floor level."

The argument is wrong because it can be clearly demonstrated that the best way to heat by mechanically circulated air is from overhead. The natural convection currents of air are negligible compared with circulation induced mechanically. What is more important, however, is the fact that we have a *cooling* rather than a heating problem in the Winter precisely as we have in Summer. The only difference is, that cold air from out of doors can be washed and used instead of operating the refrigeration machine.

It comes about in this way. The animal heat from the audience and the heat from the lights is sufficient to overheat the theatre on the coldest Winter day. The heat from thirty people is more than sufficient to heat an average room of 20 feet by 30 feet. Consider then, the heat delivered by 2,000 or more people closely seated in a theatre.

Thus, in a scientifically conditioned theatre, no steam heat whatever is required or used when the house is well filled. The air conditioning equipment takes care of this automatically, turning heat on or off as the conditions require and introducing cool air from out of doors when cooling is necessary.

The Carrier Organization

If you are not already acquainted with the Carrier Engineering Corporation, you will want to know with what authority we have spoken in these pages. We are an organization of trained engineers who have specialized for more than twenty years in the design and installation of equipment to manufacture weather within buildings. More specifically, our work has been to create and maintain any desired conditions of humidity, temperature and air movements in buildings. This, after all, *is to manufacture weather, isn't it?*

Until recently our activities have been devoted principally to industrial problems. In fact, it is only through the industries that manufactured weather has reached its present state of perfection. The human body will endure much more abuse in the way of variable climatic condition than most inanimate materials. However, manufacturers have found that the incidental effect of manufactured weather, which was instituted primarily to better their product or process, has been so beneficial to the health and efficiency of the workers that from that aspect alone it has paid for itself.

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